
**Bellingham/Lake Whatcom Coal Mines
Glen Echo Mine
Preliminary Assessment Report
Whatcom County, Washington
TDD: 03-01-0002**

Ecology and Environment, Inc.
Contract: 68-S0-01-01
September 2004

Region 10
START-2

Superfund Technical Assessment and Response Team

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**BELLINGHAM/LAKE WHATCOM COAL MINES
GLEN ECHO MINE
PRELIMINARY ASSESSMENT REPORT
WHATCOM COUNTY, WASHINGTON
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LIST OF ACRONYMS

<u>Acronym</u>	<u>Definition</u>
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
cfs	cubic feet per second
CLP	Contract Laboratory Program
CRQL	Contract Required Quantitation Limit
E & E	Ecology and Environment, Inc.
EPA	United States Environmental Protection Agency
IDW	investigation-derived waste
mg/kg	milligrams per kilogram
NWI	National Wetlands Inventory
PAs	preliminary assessments
PPE	probable point of entry
ppm	parts per million
SQL	Sample Quantitation Limit
START	Superfund Technical Assessment and Response Team
TDL	target distance limit
USGS	United States Geological Survey

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1. INTRODUCTION

Ecology and Environment, Inc. (E & E) was tasked by the United States Environmental Protection Agency (EPA) to provide technical support for completion of preliminary assessments (PAs) and pre-Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) screenings at several abandoned coal mines in the Bellingham/Lake Whatcom area, located in Whatcom County, Washington. The EPA is doing this work in response to a citizens' petition filed by two environmental groups in Bellingham, the Environmental Exposure Network and the Clean Water Alliance. These groups believe the mines may contain pollutants, such as mercury and other heavy metals. Following site visits and review of existing information, three of the mines, including the Glen Echo Mine, were selected for sampling. E & E completed PA activities under Technical Direction Document Number 03-01-0002, issued under EPA, Region 10, Superfund Technical Assessment and Response Team (START)-2 Contract Number 68-S0-01-01.

The specific goals for the Glen Echo Mine PA, identified by the EPA, are:

- Determine the potential threat to public health or the environment posed by the site;
- Determine the potential for a release of hazardous constituents into the environment; and
- Determine the potential for placement of the site on the National Priorities List.

Completion of the PA included reviewing existing site information, collecting receptor information within the range of site influence, determining regional characteristics, and conducting a site visit. This document includes a discussion of background site information (Section 2), a discussion of migration/exposure pathways and potential receptors (targets; Section 3), conclusions (Section 4), and a list of pertinent references (Section 5).

2. SITE BACKGROUND

2.1 SITE LOCATION

Two former coal mines in Whatcom County have historically been referred to as the Glen Echo Mine. One of the mines is relatively well documented, and is referred to consistently as the “Glen Echo Mine.” The other mine is poorly documented, and has been referred to as the “old original Glen Echo Mine” as well as the “old Raper Mine.” (Jenkins 1923)

For the purposes of this report, the mines are henceforth referred to as the “Glen Echo Mine” and the “Original Glen Echo Mine,” respectively. These two mines are described below.

Site Name:	Glen Echo Mine
CERCLIS ID Number:	WAN001002482
Location:	Whatcom County, Washington
Latitude:	48° 48' 20" North
Longitude:	122° 18' 37" West
Legal Description:	Sections 4, 5, 8, and 9, Township 38 North, Range 4 East, Willamette Meridian
Congressional District:	Washington
Site Owner:	Crown Pacific Partners, L.P. P.O. Box 28 Hamilton, Washington 98255 360/826-3951
Site Contact:	Russ Paul, Land and Timber Manager Crown Pacific Partners, L.P. P.O. Box 28 Hamilton, Washington 98255 (360) 826-3951

Site Name:	Original Glen Echo Mine
CERCLIS ID No.:	WAN001002482
Location:	Whatcom County, Washington
Latitude:	48° 49' 1" North
Longitude:	122° 18' 35" West
Legal Description:	Northwest 1/4 Section 4, Township 38 North, Range 4 East, Willamette Meridian
Congressional District:	Washington
Site Owner:	Marcia S. Duvall Trust of the Stewart Family Trust 3332 Kelly Road Bellingham, Washington 98226-9506 (360) 592-2856
Site Contact:	Marcia S. Duvall 3332 Kelly Road Bellingham, Washington 98226-9506 (360) 592-2856

2.2 SITE DESCRIPTION/OWNERSHIP HISTORY

The Glen Echo Mine and the Original Glen Echo Mine are discussed below. The Glen Echo Mine is an inactive coal mine that began operations in 1920 (Moen 1969). The former mine is located largely in recently clear-cut wooded area between two tributaries of Anderson Creek, in Sections 4, 5, 8, and 9, Township 38 North, Range 4 East, Willamette Meridian (Figure 2-1). In the vicinity of the mine, one of the tributaries flows generally southwest through the southeast $\frac{1}{4}$ of Section 5, Township 38 North, Range 4 East, and the other tributary flows generally west-southwest through the northeast $\frac{1}{4}$ of Section 8, Township 38 North, Range 4 East. These tributaries are referred to in this report as the north fork and east fork, respectively. The mine portals and associated surface facilities were located within the steep-walled ravine of the east fork of Anderson Creek.

The Glen Echo Mine targeted the No. 1 seam, the lowest of five coal seams. The No. 1 seam is an average of 5 feet thick (Moen 1969). The No. 1 seam strikes north 60° east and dips between 75° and 80° northwest near the mine opening (Jenkins 1923; Vonheeder 1975). Within the mine workings, the seam strikes north 30° east and dips between 10° and 30° northwest (Moen 1969).

The main workings in 1922 consisted of “the No. 1 tunnel, which is 600 feet long and which follows the coal seam on the strike, from the surface of the hillside until the tunnel enters glacial drift

which also lies very close to the surface” (Jenkins 1923). The “No. 1 tunnel is connected with the surface above by airways, where coal was also removed” (Jenkins 1923).

As of 1944, the main workings consisted of the “main slope,” which originates in Section 4 near the corner of Sections 4 and 8, and which follows the coal seam generally down dip toward the northwest for approximately 1,200 feet (WCCM 1944). A series of entries are driven from the main slope to the northeast and southwest (WCCM 1944). Historic site features as of 1944 are illustrated in Figure 2-2.

In addition to the main workings described above, there are several prospect holes located on the south side of the east fork of Anderson Creek. One of the openings is an inclined shaft that follows the coal seam down the dip for 150 feet. The shaft was entirely filled with water during Jenkins’ 1922 visit to the mine. (Jenkins 1923; WCCM 1944)

As of 1944 (WCCM 1944), surface features of the Glen Echo Mine included the following:

- Access road along the east fork of Anderson Creek;
- Hoist near the main slope portal;
- A cluster of buildings near the main slope portal;
- A rail tramway extending approximately 1,000 feet westward from the main slope portal to the coal washing plant;
- The coal washing plant;
- Water reservoir near the coal washing plant; and
- Rock dump near the coal washing plant.

The Glen Echo Mine was opened in 1920 under ownership by the Glen Echo Coal Mining Company (Jenkins 1923). In 1943, the mine was owned by the West Coast Mines, Inc. (Green 1943). In 1947 the mine was owned by West Coast Coal Company, located in Bellingham, Washington (Green 1947).

The Original Glen Echo Mine is located approximately 1 mile north of the Glen Echo Mine, near the northeast corner of Section 4, Township 38 North, Range 4 East (Figure 2-1). The mine is “said to be the old original Glen Echo mine, which is sometimes called the old Raper mine” (Jenkins 1923). It is further reported that “it is said that this tunnel is 300 feet long,” and that “there is a pile of old slack coal on the dump with a quantity of black coaly shale” (Jenkins 1923). No further information on the mine has been identified. No map of the Original Glen Echo Mine is available. Information on the ownership history of the Original Glen Echo Mine could not be located during the PA.

2.3 SITE OPERATIONS AND WASTE CHARACTERISTICS

This subsection provides information on the operations and waste characteristics of the Glen Echo Mine. No information on operations at the Original Glen Echo Mine is available.

The Glen Echo Mine operated sporadically between 1920 and 1948. Available production records are summarized below. The mine produced 1,000 tons in 1920, ceased production in 1921, and resumed production in 1927. Between 1932 and 1947, annual production averaged approximately 4,100 tons. No production records are available for the period 1927 to 1931. (Vonheeder 1975)

Coal was removed by the room and pillar method, in which rooms are mined out and pillars of coal are left behind to support the mine roof. Typically, approximately half the coal is removed and the rest left behind as pillars. By at least 1943, the coal seam was undercut by a Sullivan shortwall machine and conveyed to the entry on a Vulcan shaking conveyor (Green 1943 and 1947). At the time mining operations terminated the total area of underground workings was approximately 15 acres (Moen 1969).

The coal was hoisted to the surface via the main slope and transported by rail tram to the coal washing plant located approximately 1,000 feet downstream along the east fork of Anderson Creek (Jenkins 1923; Green 1943 and 1947; WCCM 1944; Moen 1969). The main hoist was electric (Green 1943 and 1947). Underground haulage was accomplished using mules and airtuggers (Green 1943 and 1947). Underground ventilation was provided by a Sirocco type exhaust fan (Green 1943 and 1947).

Coal preparation as of 1922 is described as follows:

The bunkers are 34 x 110 x 90 feet high. The coal was dumped from the mine cars into a hopper, then passed over a 1 ½-inch mesh screen. The lump coal was passed over a picking table, cleaned there, and sent into a loading bin. The finer coal was carried in a chute to gig washers. After being washed it was carried by a 16-foot elevator and dropped into a classifier where it was sorted into fine coal, pea coal, nut coal, and egg coal sizes. All these were passed into bins to a platform where trucks were loaded. The trucks had to drive over a 3,900-foot plank road to a gravel road, one mile long, and then on the Northeast Diagonal pavement to Bellingham - a total distance of ten miles. (Jenkins 1923)

Coal preparation process as of 1943 is described as follows:

The raw coal is dumped on a shaking screen and lump taken out and hand-picked. The undersize goes to a Forrester jig washer. The washer product is screened through a revolving screen and sized into eggnut, pea, stoker, and buckwheat. Shipments: By truck. (Green 1943)

2.4 SITE CHARACTERIZATION

Based on available information, no investigations of the Glen Echo Mine or Original Glen Echo Mine have been conducted. However, ancillary information gathered as part of the PA may be pertinent to the mines, as discussed below.

The United States Geological Survey (USGS) has collected information on coal sampled from across the United States over the last 25 years (Tewalt et al. 2001). Results are compiled in USGS's COALQUAL database (USGS 2004a). Although most samples represented in the database were collected from major coal producing areas around the country, two coal samples were collected from exposures of the Chuckanut Formation in Whatcom County (near Glacier, Washington) and Skagit County (near Hamilton, Washington) in 1979 and 1975, respectively. The Chuckanut Formation is the geologic unit that contains the coal beds developed in the Bellingham/Lake Whatcom area (Jenkins 1923). These two samples were collected from distances greater than 20 miles from the Bellingham/Lake Whatcom area coal mines (including the Glen Echo Mine), and may not be representative of the coal beds targeted in the Bellingham/Lake Whatcom area mines. Nonetheless, it is important to note that the total mercury concentrations in these samples were relatively high, at 0.46 parts per million (ppm) and 1.1 ppm (USGS 2004a). By comparison, for the more than 7,000 samples in the COALQUAL database, the mean mercury concentration is 0.17 ppm, and the median concentration is 0.11 ppm. The maximum mercury database value for coal in the ground is 1.8 ppm, after deleting one higher value as a statistical outlier (Tewalt et al. 2001).

2.5 START-2 ACTIONS

To obtain information about coal mining in the Bellingham/Lake Whatcom area, including the area of the Glen Echo Mine, START-2 reviewed numerous reports, maps, and other documents. In addition, the START-2 and conducted interviews with representatives of federal, state, and local agencies; representatives of academic institutions; and owners or representatives of properties in the vicinity of the former coal mining activities. A list of these data sources for the Bellingham/Lake Whatcom Coal Mines PA/pre-CERCLIS screening project is provided in Appendix A.

All pertinent information gathered has been incorporated into this PA report, and was used to guide efforts to physically locate the Glen Echo Mine and Original Glen Echo Mine during site reconnaissance visits performed by START-2. START-2 conducted a site visit to the Original Glen Echo Mine on July 9, 2003. The START-2 also conducted site visits to the Glen Echo Mine on July 9, 2003,

February 11, 2004, and July 2, 2004. Observations made during the site visits are summarized below. Photographic documentation of the site visits is provided in Appendix B.

START-2 personnel visited the Original Glen Echo Mine on July 9, 2003. The START-2 personnel were accompanied by the site owner, Marcia Duvall. Ms. Duvall stated that she purchased the mine property in 2000. Ms. Duvall was familiar with the mine location, and led the START-2 through a wooded thicket to a portal at the base of a hillside. The area in the vicinity of the portal was covered with decaying fallen logs and was overgrown with immature trees, ferns, and brush, thereby obscuring details of the mine features. The portal was caved around a 3-foot diameter corrugated plastic pipe that protrudes approximately 10 feet from the hillside. The pipe apparently was installed to prevent complete collapse of the portal and to allow drainage from the portal. A wire mesh was installed at the end of the 3-foot pipe to limit access while allowing water to flow from the portal. At the time of the site visit, water was flowing from the portal at a rate estimated at less than 1 gallon per minute. A 2-inch diameter black plastic pipe was observed approximately 30 feet west of the portal. Ms. Duvall stated that the nearby Zervas residence, located immediately west of the Duvall property, utilizes the water flow from the portal for domestic water supply. The 2-inch diameter pipe likely is the supply pipe. No waste rock piles or other sources were identified. Besides the portal, no evidence of coal mining was observed by START-2.

START-2 visited the area of the Glen Echo Mine on July 9, 2003, in an attempt to locate features associated with the former mine. START-2 drove via logging roads maintained by Crown Pacific Partners, L.P., to a former rendering plant located on Whatcom County parcel number 380408334485. From the former rendering plant parking lot, START-2 walked eastward generally along the east fork of Anderson Creek through a recently clear-cut area presently overgrown with brush. The START-2 utilized a global positioning system unit pre-programmed waypoint locations of former mine features approximated from historic mine maps to attempt to locate the mine features. Due to dense vegetation, access and visibility were very limited. No obvious mine features were observed. Only a former road, which was locally washed out, was observed.

On February 11, 2004, START-2 returned to the Glen Echo Mine area to again attempt to locate and characterize mine features. During the winter months, the vegetation was subdued, facilitating improved access and visibility. Mine features not previously noted were observed. The following observations were made during the February 11, 2004, site visit:

- Sections of iron rail, several ore cars (Photographs 6 and 7, Appendix B), sections of metal pipe, pieces of corrugated sheet metal, a boiler carcass, and numerous pieces of

unidentified metal debris were observed in the bed or along the banks of the east fork of Anderson Creek. The positions of the ore carts and other items and the deformed nature of the rails and other debris clearly indicated they were transported to their current positions by slope failure and torrential flooding.

- Upstream of the debris observed in and along the streambed, a hoist and associated metal machinery apparently formerly used to haul ore carts out of the main slope opening, as well as pieces of corrugated sheet metal, were found scattered on a flat bench approximately 50 feet wide along the northern bank of the east fork of Anderson Creek (Photograph 4, Appendix B). The gear wheel of the hoist is approximately 6 feet in diameter. Based on its large size, it is likely that the hoist has not been transported far from its position of use during mine operation, and, as such, the main slope portal is believed to be located near the hoist. A search for the mine opening along the embankment north of the hoist did not reveal any obvious mine openings, although a localized topographic depression along the hillside north of the hoist could be a collapsed portal. No other indications of mining activities were noted in the area of the hoist.
- Approximately 300 feet downstream of the hoist, on the steep north bank of the east fork of Anderson Creek, the START-2 observed the remains of a roadbed (locally washed out by the creek) and former buildings, including a 4-foot high, 50-foot long concrete wall, and scattered pieces of corrugated sheet metal, a wooden cabinet, and an empty, rusted 55-gallon drum. A 1-inch diameter wire rope that may have been a component of a rail tram system to move ore cars between the mine opening and the coal washing plant (WCCM 1944) also was observed.
- Coal fragments were observed in the bed of the east fork of Anderson Creek. It was not possible to determine whether the fragments are attributable to former coal mining and processing activities or natural erosion of coal-bearing strata such as the layer of coal observed on the north bank of the east fork of Anderson Creek in the vicinity of the Glen Echo Mine (Photographs 10 and 11, Appendix B).
- Based on the historic mine map (WCCM 1944) and site topography, all the aboveground mine features and associated facilities are located on the steep walls of the east fork Anderson Creek drainage. Several slope failures and erosion were noted during the START-2 site visits. Some of the observed mine site features have clearly been subjected to such erosion. It is likely that some of the features believed to exist based on the historic mine map (WCCM 1944) but not observed in the field also have been obliterated or relocated by slope failures and stream erosion.

On July 2, 2004, START-2 returned to the site to perform limited sampling. Samples of sediment, soil, and coal/coaly waste rock were collected. During the July 2, 2004, site visit, several mine additional features believed to be associated with the coal washing plant depicted on the historic mine map (WCCM 1944) were identified. The features were located on the steep north bank of the east fork of Anderson Creek. Features observed include a rusted iron wheel (Photograph 14, Appendix B), iron rail, sheet metal, and metal screen that likely was a component of the coal washing system. In addition, coal and/or coaly waste rock was observed scattered on the steep slope extending down to the east fork of

Anderson Creek in the area of the suspected coal washing area. The material was largely covered by decaying vegetation, thus obscuring its extent (Photographs 15 and 16, Appendix B). The areal extent of the material was estimated to cover an area approximately 70 feet wide and 100 feet long, with a smaller adjacent area approximately 30 feet by 30 feet.

During this site visit START-2 performed limited soil and sediment sampling. Sample locations are illustrated in Figure 2-3. A surface soil sample (04274060) of coal/coaly waste rock (source material) was collected from the area of the former coal washing area (location GE02), and a sample of background soil (04274062) was collected at a location (GE04) east of the former mine workings and surface facilities. A target sediment sample (04274059) was collected from the east fork of Anderson Creek approximately 500 feet downstream of the former coal washing plant (location GE01). A background sediment sample (04274061) was collected from the east fork of Anderson Creek approximately 700 feet upstream of the hoist, which is apparently situated at the location of the main slope of the mine (GE03).

Samples were collected in accordance with the *Bellingham/Lake Whatcom Coal Mines Sampling and Quality Assurance Plan* (E & E 2004). Investigation-derived waste (IDW) generated during the sampling activities consisted of dedicated plastic scoops and bowls and personal protective equipment; IDW was disposed of at a municipal landfill. Each sample was analyzed for Target Analyte List metals and mercury following EPA Contract Laboratory Program (CLP) Statement of Work ILM05.3 (EPA 2004) by Bonner Analytical Testing Company of Hattiesburg, Mississippi, under the EPA CLP.

Analytical results of the soil and sediment samples are presented in Tables 2-1 and 2-2, respectively. Laboratory data forms are provided in Appendix C. Tables 2-1 and 2-2 show all analytes detected above laboratory detection limits in bold type. Analytical results indicating significant concentrations of contaminants in the source sample with respect to background soil concentrations are shown underlined and in bold type. For the purposes of this investigation, significant/elevated concentrations are those concentrations that are:

- Equal to or greater than the sample's Contract Required Quantitation Limit (CRQL) or the sample quantitation limit (SQL) when a non-CLP laboratory was used; and
- Equal to or greater than the background sample's CRQL or SQL when the background concentration is below detection limits; or
- At least three times greater than the background concentration when the background concentration equals or exceeds the detection limits.

The analytical summary tables present all detected compounds, but only those detected analytes at potential sources or in targets meeting the significant/elevated concentration criteria are discussed in

the report text. Based on EPA Region 10 policy, evaluation of aluminum, calcium, iron, magnesium, potassium, and sodium (common earth crust metals) generally is employed in water mass tracing, which is beyond the scope of this report. For this reason, these elements are included in the summary tables, but are not discussed in the report text.

Arsenic, barium, and copper are the only contaminants detected at significant concentrations with respect to background soil concentrations in the source sample (04274060). Arsenic was detected at a concentration of 6.4 milligrams per kilogram (mg/kg). Barium was detected at 368 mg/kg. Copper was detected at 68.0 mg/kg. No contaminants were detected at elevated concentrations in the target sediment sample (04274059).

Table 2-1		
SURFACE SOIL SAMPLE ANALYTICAL RESULTS SUMMARY		
BELLINGHAM/LAKE WHATCOM COAL MINES		
GLEN ECHO MINE		
PRELIMINARY ASSESSMENT		
WHATCOM COUNTY, WASHINGTON		
EPA Sample ID	04274062	04274060
CLP Inorganic ID	MJ45N4	MJ45N2
Station Location ID	GE04	GE02
Description	Background Soil	Coaly Waste Rock
TAL Metals (mg/kg)		
Aluminum	21000	13500
Antimony	R	7.2 UJL
Arsenic	2.1	<u>6.4</u>
Barium	88.8	<u>368</u>
Beryllium	0.39 J (SQL = 1.19)	0.63
Cadmium	0.43 J	0.58 J
Calcium	2630	11000
Chromium	44.1	30.1
Cobalt	11.2	7.1
Copper	16.6	<u>68.0</u>
Iron	22300	11500
Lead	6.9	15.2
Magnesium	4750	2750
Manganese	331	182
Mercury	0.60 U	0.18
Nickel	53.6	30.5
Potassium	655	1310
Selenium	4.2 U	4.2 U
Silver	1.2 U	1.2 U
Sodium	101 U	104 U
Thallium	2.9 J	0.81 J
Vanadium	56.1	74.0
Zinc	58.6	53.6

Note: Bold type indicates the sample result is above the detection limit.
 Underlined type indicates the sample result is significant as defined in Section 2.

Key:

CLP	= Contract Laboratory Program.
EPA	= United States Environmental Protection Agency.
ID	= Identification.
J	= The associated value is an estimated quantity. The value is greater than the method detection limit, but less than the laboratory's quantitation limit.
L	= Low bias.
mg/kg	= Milligrams per kilogram.
R	= The data are unusable. The analyte may or may not be present in the sample.
SQL	= Sample quantitation limit.
TAL	= Target Analyte List.
U	= The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Table 2-2

SEDIMENT SAMPLE ANALYTICAL RESULTS SUMMARY
BELLINGHAM/LAKE WHATCOM COAL MINES
GLEN ECHO MINE
PRELIMINARY ASSESSMENT
WHATCOM COUNTY, WASHINGTON

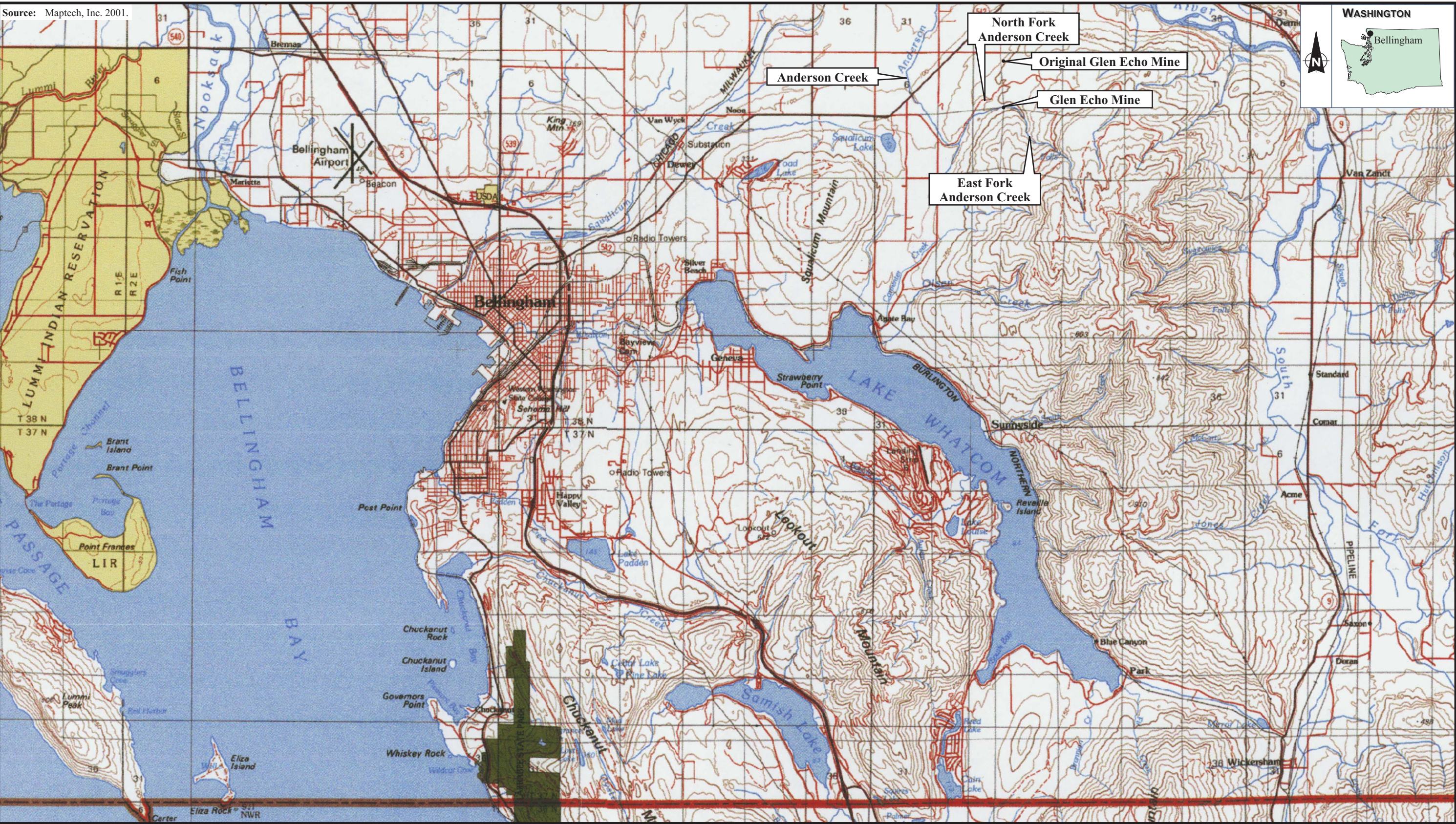
EPA Sample ID	04274061	04274059
CLP Inorganic ID	MJ45N3	MJ45N1
Station Location ID	GE03	GE01
Description	Background Sediment	Downstream Sediment
TAL Metals (mg/kg)		
Aluminum	14300	16000
Antimony	R	R
Arsenic	1.9	1.7
Barium	74.7	71.4
Beryllium	0.41 J	0.43 J
Cadmium	0.35 J	0.38 J
Calcium	4880	5000
Chromium	115	158
Cobalt	16.1	21.0
Copper	13.3	18.1
Iron	21200	25700
Lead	3.3	3.6
Magnesium	14700	19300
Manganese	368	351
Mercury	0.63 U	0.62 U
Nickel	196	316
Potassium	930	1080
Selenium	1.5 J	1.3 J
Silver	1.3 U	1.2 U
Sodium	164 U	131 U
Thallium	2.5 J (SQL = 3.78)	3.2
Vanadium	44.4	48.4
Zinc	38.1	47.7

Note: Bold type indicates the sample result is above the detection limit.

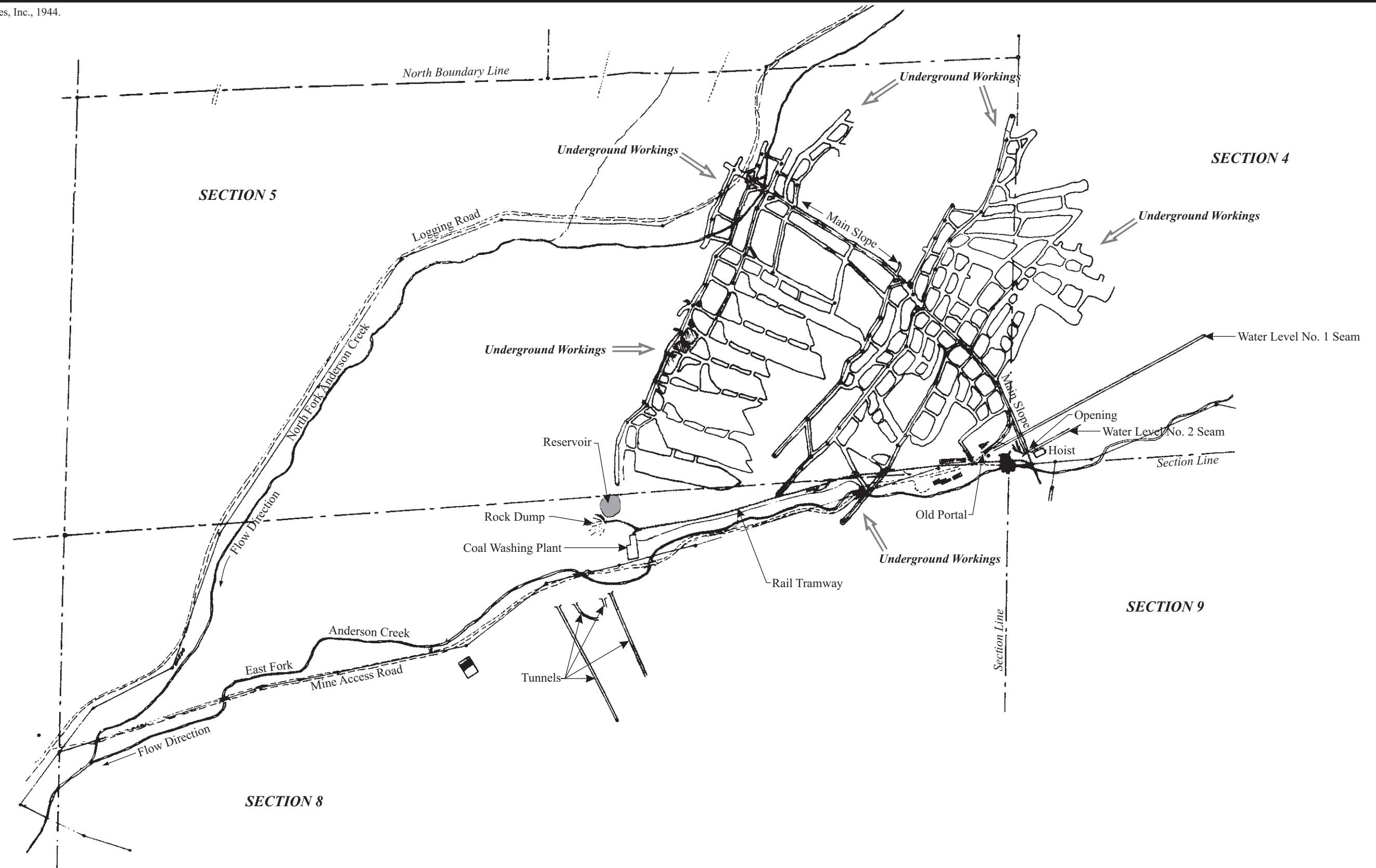
Key:

CLP	= Contract Laboratory Program.
EPA	= United States Environmental Protection Agency.
ID	= Identification.
J	= The associated value is an estimated quantity. The value is greater than the method detection limit, but less than the laboratory's quantitation limit.
mg/kg	= Milligrams per kilogram.
R	= The data are unusable. The analyte may or may not be present in the sample.
SQL	= Sample quantitation limit.
TAL	= Target Analyte List.
U	= The material was analyzed for, but was not detected above the level of the associated value. The associated value is either the sample quantitation limit or the sample detection limit.

Source: Maptech, Inc. 2001.



Source: West Coast Coal Mines, Inc., 1944.



0 150 300
Approximate Scale in Feet

BELLINGHAM/LAKE WHATCOM COAL MINES
Whatcom County, Washington

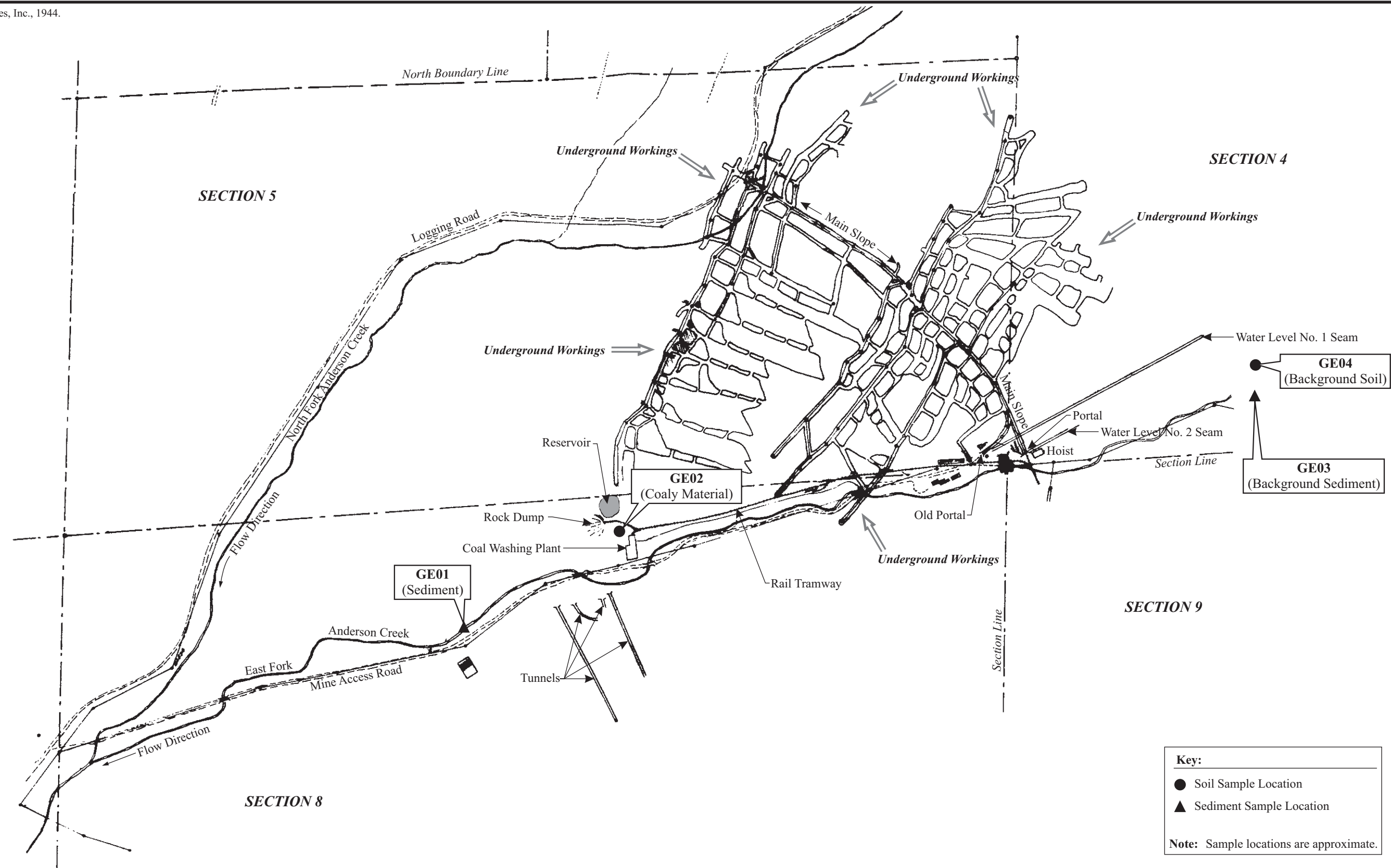
Figure 2-2
HISTORIC MINE MAP
GLEN ECHO MINE

Date:
9/20/04

Drawn by:
AES

10:START-2\03-01-0002\fig 2-2

Source: West Coast Coal Mines, Inc., 1944.



3. MIGRATION/EXPOSURE PATHWAYS AND TARGETS

This section describes migration/exposure pathways and potential targets (or receptors) within the site's range of influence. This section addresses only the surface water migration pathway and potential targets within the site's range of influence. The groundwater migration, soil exposure, and air migration pathways have been excluded at this time per direction of the EPA Task Monitor because relatively few receptors have been identified for these pathways.

The surface water migration pathway target distance limit (TDL) begins at the probable point of entry (PPE) of surface water runoff from the site to a surface waterbody and extends downstream for 15 miles. Figure 3-1 depicts the surface water 15-mile TDLs for both the Glen Echo Mine and the Original Glen Echo Mine.

Surface water in the vicinity of Glen Echo Mine will travel overland distances less than 100 feet from potential source areas to the east fork of Anderson Creek, the PPE. From the PPE, surface water continues approximately 1.1 miles to the confluence with the main stem of Anderson Creek and onward to the confluence with the Nooksack River, approximately 6.4 miles downstream of the PPE. The surface water TDL concludes approximately 7.5 miles further down the Nooksack River.

Surface water in the vicinity of the Original Glen Echo Mine will travel overland from the mine portal toward the southwest, approximately 1.6 miles to the PPE in Anderson Creek. From the PPE, surface water continues in Anderson Creek for approximately 5 miles to its confluence with the Nooksack River. Surface water will then flow approximately 10 miles in the Nooksack River to the TDL for the Original Glen Echo Mine.

Anderson Creek downstream of the confluence of the east fork and main stem has an annual average flow rate of 21.7 cubic feet per second (cfs; USGS 2004b). Based on this statistic, START-2 estimates an average annual flow rate in the east fork of one-half the amount in the main stem, or 10.9 cfs. The Nooksack River near Lynden, Washington, which lies a few miles downstream of the end of the 15-mile TDL, had an annual average flow rate of 3,705 cfs between 1945 and 1966 (USGS 2004c).

Potential source areas at the mine have no containment to prevent a release of hazardous substances to the surface water pathway. START-2 estimates the drainage area above and including the potential source areas at 1,074 acres (USGS 1994). Soils in the vicinity of the site consist of Andic Xerochrepts with 60% to 90% slopes. They formed in volcanic ash, colluvium derived from glacial till,

sandstone, and metasedimentary rocks. Permeability is moderate to moderately rapid, and available water capacity is moderate to high. Runoff is medium, and the hazard of water erosion is severe (USDA 1992). The two-year, 24-hour probable maximum rainfall for the Bellingham area is 2.5 inches (NOAA 1973). START-2 assumes the potential sources of Glen Echo Mine are affected annually by flood events in the east fork of Anderson Creek.

Surface water is not used for drinking water within the surface water TDL. One surface water intake within Anderson Creek and two surface water intakes within the Nooksack River provide water for irrigation. (Ecology 2004a).

Sport fishing regularly occurs in the Nooksack River, and Washington Department of Fish and Wildlife tracks the harvest of salmon and steelhead from the Nooksack River. For 1999, the most recent summarized data set, 740 salmon and steelhead were harvested from the river (WDFW 2002). START-2 assumes that 24% of this harvest amount occurred within the surface water TDL because the percentage of the Nooksack River that lies within the surface water TDL is approximately 24% of the river's run. No Tribal or subsistence fisheries were identified in the TDL. Table 3-1 provides harvest data per fish species.

The following sensitive environments are located within the surface water pathway TDL:

- The east fork of Anderson Creek, Anderson Creek, and the Nooksack River are critical migratory pathways for anadromous fish (WDFW 2003); and
- A winter concentration area for the bald eagle, *Haliaeetus Leucocephalus*, a Federal-listed threatened species, occurs west of Everson, Washington, along the Nooksack River (WDFW 2004).

For the Glen Echo Mine, it is estimated from National Wetland Inventory (NWI) maps that 24.74 miles of wetland frontage occur along the 15-mile surface water pathway TDL. The east fork of Anderson Creek has 1.11 miles of wetland frontage, Anderson Creek has 7.67 miles of wetland frontage, and the Nooksack River has the remaining 15.96 miles of wetland frontage (USFWS 1997a, 1997b, 1997c, 1997d, 1997e, and 2001).

For the Original Glen Echo Mine, it is estimated from NWI maps that 23.34 miles of wetland frontage occur along the 15-mile surface water pathway TDL. Anderson Creek has 5.84 miles of wetland frontage, and the Nooksack River has the remaining 17.5 miles of wetland frontage (USFWS 1997e, 1997f, 1997g, and 1997h).

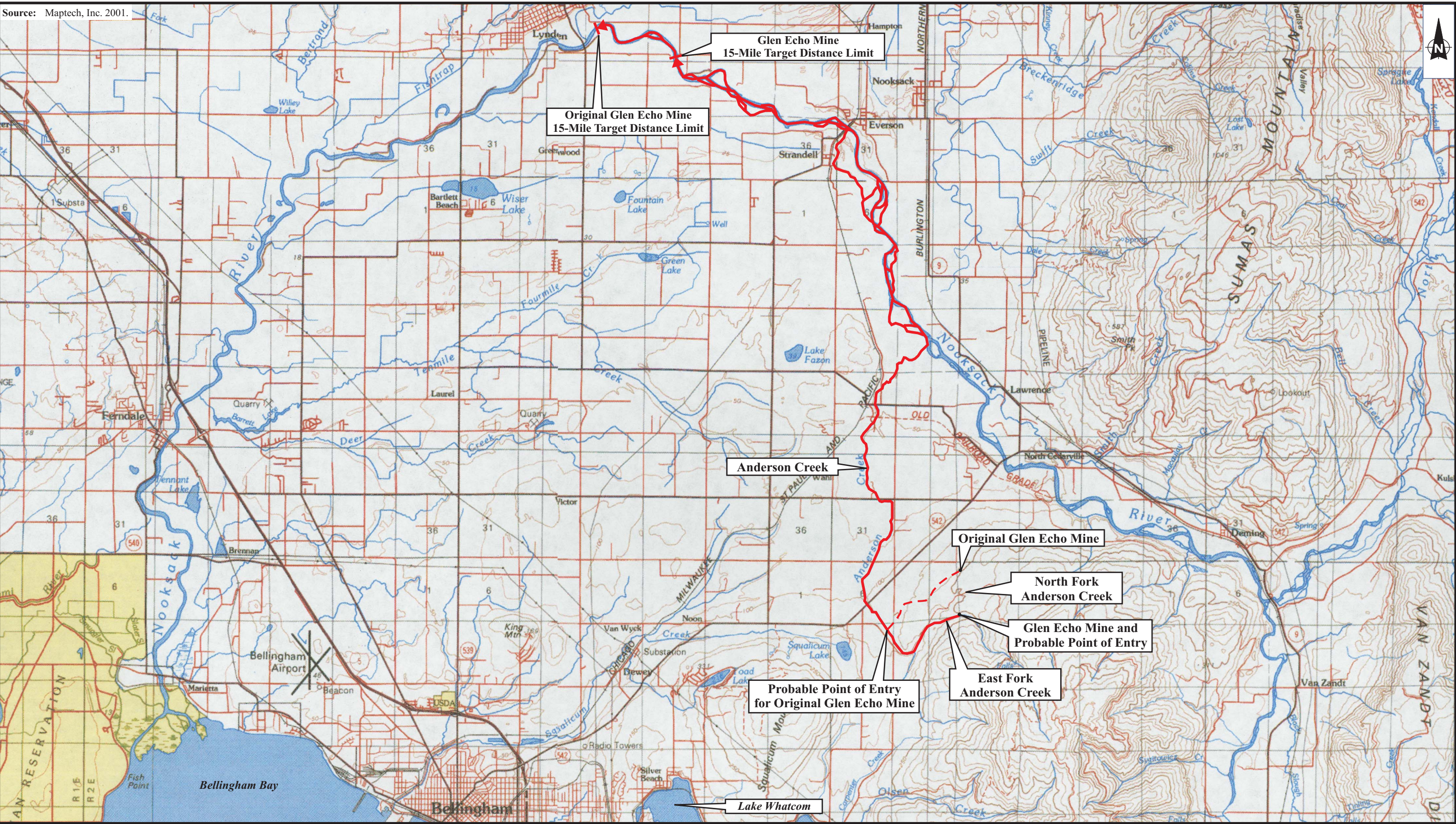
Table 3-1 FISH HARVEST WITHIN THE 15-MILE TARGET DISTANCE LIMIT BELLINGHAM/LAKE WHATCOM COAL MINES GLEN ECHO MINE AND ORIGINAL GLEN ECHO MINE PRELIMINARY ASSESSMENT WHATCOM COUNTY, WASHINGTON				
Stream Segment	Fish Species	Number Harvested	Average Pound per Fish^a	Pounds Harvested
Nooksack River	Chinook Salmon	1	22	22
	Coho Salmon	650	8	5,200
	Pink Salmon	31	4	124
	Chum Salmon	51	9	459
	Steelhead	7	5 ^b	35
Total		740		5,840

Source: WDFW 2002.

^a Average pound per fish gathered from Wydoski and Whitney 1979.

^b Estimated by START-2.

Source: Maptech, Inc. 2001.



Anderson Creek

Probable Point of Entry
for Original Glen Echo Mine

Lake Whatcom

Glen Echo Mine
15-Mile Target Distance Limit

Original Glen Echo Mine
15-Mile Target Distance Limit

Original Glen Echo Mine

North Fork
Anderson Creek

Glen Echo Mine and
Probable Point of Entry

East Fork
Anderson Creek

4. CONCLUSIONS

Information on the Original Glen Echo Mine is limited. Available information suggests that the mine ceased operating by 1923 and consisted of a 300-foot long adit and an associated waste rock pile. During a site visit, START-2 observed an apparent portal collapsed around a 3-foot diameter corrugated plastic pipe. A 2-inch diameter plastic pipe protruded from the portal, and reportedly conveys water from the portal to a nearby residence for domestic water supply. No sources or evidence of contamination (e.g., stained soil, distressed vegetation) were observed during the visit.

The Glen Echo Mine is an abandoned coal mine that operated sporadically between 1920 and 1948. Total coal production is not known; however, annual production averaged approximately 4,100 tons between 1932 and 1947. No information on abandonment of the mine is available. Evidence of the former mining operations observed by START-2 during the site visits includes equipment (e.g., a hoist, iron rails, ore carts) and scattered coal or coaly waste rock in the former coal washing area. Arsenic, barium, and copper were detected at significant concentrations in the source soil sample (coal or coaly waste rock). No contaminants were detected at elevated concentrations in the target sediment sample.

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APPENDIX A
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- Smith, Kathy, 2004, United States Geological Survey (USGS), personal communication with Mark Longtine, E & E, Seattle, on March 2, 2004, regarding trace metals in coal.
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- Wahl, Tim, 2003, Real Estate Specialist, City of Bellingham, Parks and Recreation Department, personal communication with Mark Longtine, E & E, Seattle, on April 15 and 28, 2003, regarding abandoned coal mines in the Bellingham and Lake Whatcom area.
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PROJECT DATA SOURCES:

RESEARCH FACILITY CONTACTS

Bellingham Public Library
210 Central Avenue
Bellingham, Washington 98225
Margaret Ziegler, Reference Librarian

Center for Pacific Northwest Studies/Washington State Archives: Northwest Regional Branch
Goltz-Murray Archives Building
Western Washington University
Bellingham, Washington 98225-9123

Washington State Department of Natural Resources
Division of Geology and Earth Resources
1111 Washington Street SE, Room 148
P.O. Box 47007
Olympia, Washington 98504-7007

APPENDIX B
PHOTOGRAPHIC DOCUMENTATION

PHOTOGRAPH IDENTIFICATION SHEET

Cameras: Kodak Max HQ Flash 35 mm reusable camera (Photos A-1 through A-3)

Fujifilm Quicksnap 35mm reusable camera (Photos A-8 through A-12) TDD No. 03-01-0002

Lens Type: 35mm

Site Name: Glen Echo Mine

Photo	Time	Date	By	Direction	Description
1	0958	7/9/03	ML	E	Portal of Original Glen Echo Mine. Note plastic culvert and screen. Backpack and logbook for scale.
2	1001	7/9/03	ML	Down/ NE	Portion of collapsed portal above plastic culvert and below downed tree at Original Glen Echo Mine. Logbook for scale.
3	1003	7/9/03	ML	E	Portal of Original Glen Echo Mine.
4	1235	2/11/04	ML	E	Hoist at suspected location of Main Slope portal, Glen Echo Mine. Logbook and gloves for scale.
5	1250	2/11/04	ML	N	Hoist (see Photo 4) and steep slope (background), Glen Echo Mine.
6	1303	2/11/04	ML	E	Ore car, on bank of east fork of Anderson Creek, approximately 100 feet downstream of hoist area, Glen Echo Mine.
7	1332	2/11/04	ML	S	Ore cars in bed of east fork of Anderson Creek, Glen Echo Mine.
8	1334	2/11/04	ML	W	Concrete wall (center, covered with moss and ferns), Glen Echo Mine.
9	1335	2/11/04	ML	NE/ Down	Empty 55-gallon drum adjacent to the concrete wall illustrated in Photo 8.
10	1428	2/11/04	ML	NE	Coaly material on slope above east fork of Anderson Creek.
11	1431	2/11/04	ML	E	Layer of coaly material (center) illustrated in Photo 10. Layer is oriented parallel to sandstone bedding, suggesting that the coaly material is an in-situ coal seam.
12	1035	7/2/04	ML	Down	Sample GE01DG01SD01. Overcast.
13	1040	7/2/04	ML	SE	GE01 location (right). Note iron rail washed down from mine workings to left of sample location.
14	1115	7/2/04	ML	NW	Rusted iron wheel at suspected coal washing area.
15	1220	7/2/04	ML	Down	Sample GE02WP01WR01. Overcast.
16	1221	7/2/04	ML	E	GE02 location. Note machinery in background. Sample location lower left.
17	1320	7/2/04	ML	Down	Sample GE03BG01SD01. Overcast.
18	1345	7/2/04	ML	Down	Sample GE04BG02SS01. Overcast.

Key:

E	=	East.
N	=	North.
N	=	North.
S	=	South.
TDD	=	Technical Direction Document.
W	=	West.















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14





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